

3.2 Expansion joints

An expansion joint or movement joint is an assembly designed to safely absorb the heat- induced expansion and contraction of construction materials, to absorb vibration, to hold parts together, or to allow movement due to ground settlement or earthquakes. They are commonly found between sections of buildings, bridges, sidewalks, railway tracks, piping systems, ships, and other structures.

Building faces, concrete slabs and pipelines expand and contract due to warming and cooling from seasonal variation or due to other heat sources. Before expansion, joint gaps were built into these structures and they would crack under the stress induced.

We know, the Young's Modulus

$$Y = \frac{\text{Longitudinal Stress}}{\text{Longitudinal Strain}} \text{-----(1)}$$

$$\text{Longitudinal stress} = \frac{F}{A} \text{-----(2)}$$

We know that, coefficient of thermal expansion is

$$\alpha = \frac{dl}{l\theta}$$

From this, we can write longitudinal strain is

$$\text{longitudinal strain} = \frac{dl}{l} = \alpha\theta \text{-----(3)}$$

Substituting equation (2) and (3) in equation (1) we get

$$Y = \frac{F/A}{\alpha\theta}$$

$$\frac{F}{A} = Y\alpha\theta$$

$$F = Y\alpha\theta A \text{ -----(4)}$$

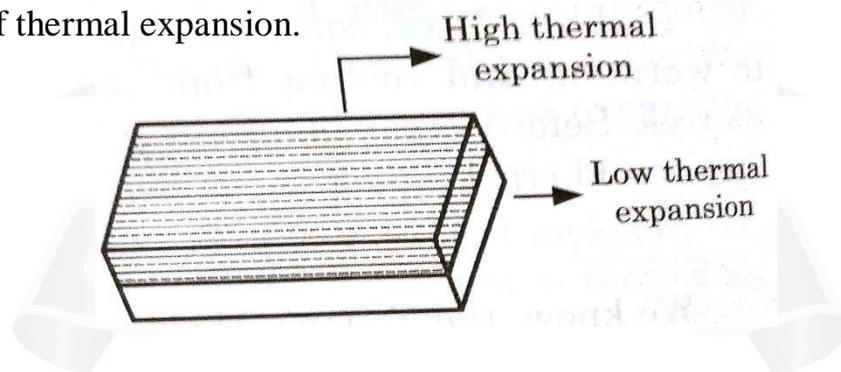
From equation (4) we can see that if the Area is less, then the force required to restore the material to its original position is less. Suppose, if the area is large then the restoring force should also be more, which is quite impossible. Hence, to avoid this problem, while constructing a large area of beams, gap is provided and these gaps are called expansion joints.

Examples

1. It is provided even in the construction of buildings. However, the joints area well packed and are not visible.
2. It is provided while laying the railway lines.

Bimetallic strips

Bimetallic strips are made up of two thin metal strips with different co-efficient of thermal expansion.

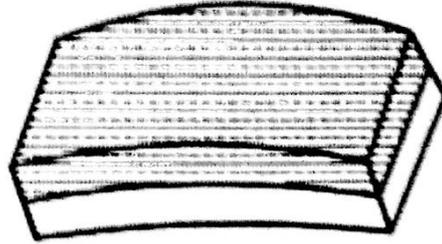


3.2.1 Bimetallic strips

Let us consider two metals are having (Brass) high co-efficient of thermal expansion and low co- efficient of thermal expansion (steel) are welded as shown in figure. This arrangement is known as bimetallic strips.

While Heating:

When the bimetallic strip is heated then the strip will start expanding and therefore the brass, which has large co-efficient of thermal expansion

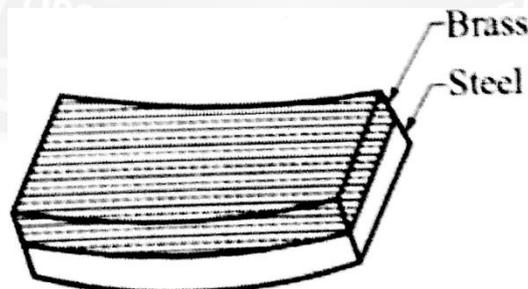


3.2.2 Bimetallic strips

expands more than the steel and hence the bimetallic strip bends like an arc as shown in figure.

While cooling:

Now, when the bimetallic strip is cooled then the strip will start contracting the therefore the brass which has large co-efficient of thermal expansion contracts more than the steel and bends like an arc as shown in figure.



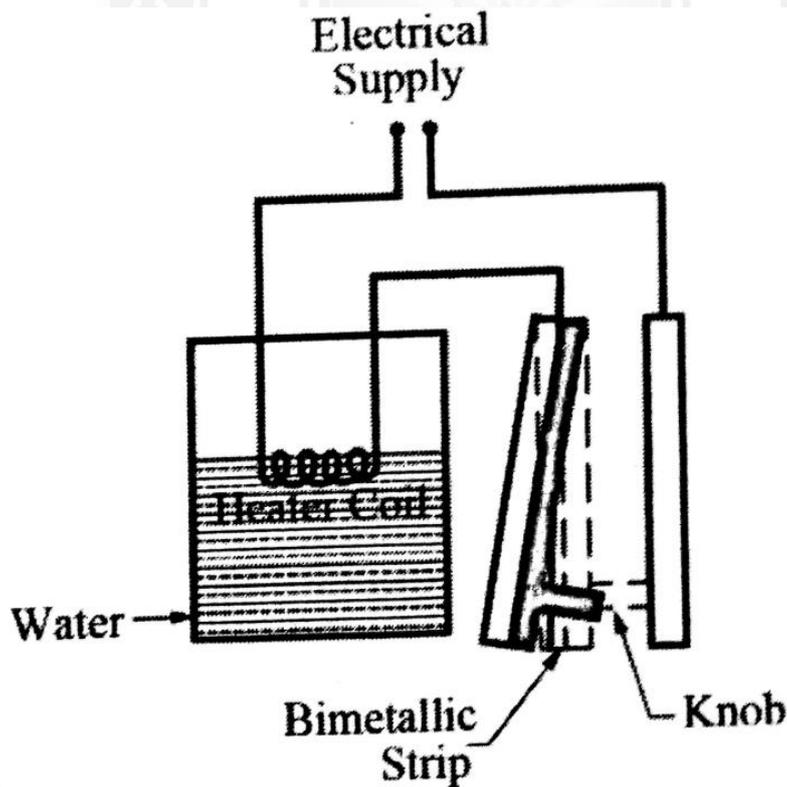
3.2.3 Bimetallic strips

Applications:

Bimetallic strips are commonly use in water heaters as temperature controller as detailed below. A water heater connected to the bimetallic strip as shown in figure. At room temperature, the bimetallic strip remains straight; the circuit is in the closed condition.

When the power supply is switched on die to increase in temperature of the water, the heater coil becomes hot and in turn, the bimetallic strip becomes hot. Now, due to thermal expansion, the bimetallic strip starts bending and at a particular temperature the knobs are detached and hence, the circuit becomes open.

Hence, the bimetallic strip acts as a temperature controller of the water



heater.

3.2.4 Bimetallic strips